

Appl. No. 10/527,182
Response to Office Action mailed July 27, 2006

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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

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Claim 1. (currently amended) A galvanized steel sheet, having an excellent in the coating adhesion, characterized in that in comprising an interface between a galvanized layer and a base steel sheet on which the galvanized layer is formed, wherein an irregularity that has a depth of 10 nm or more at a pitch of 0.5 μm or less is present at least one per 5 μm of a length of the interface.

Claim 2. (withdrawn) A galvanized steel sheet excellent in the coating adhesion characterized in that a surface shape of a

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base steel sheet that is observed after a galvanized layer is peeled has a developed interfacial area ratio Sdr measured by use of a high-pass filter with a cut-off wavelength of 0.5 μm of 2.0 percent or more.

Claim 3. (currently amended) The galvanized steel sheet having an excellent in the coating adhesion according to claim 1 ~~characterized in that~~ , wherein the base steel sheet contains, by mass percent, 0.25 percent or less of C, 0.03 to 2.0 percent of Si and 0.005 to 0.07 percent of P, with the balance being Fe and inevitable impurities, and has a composition satisfying the following equation (1) $[[.]]$:

Note

$$[C] + [P] \leq [Si] \quad (1)$$

Here wherein, [C], [P] and [Si], respectively, mean the contents $[[.]]$ in mass percent $[[.]]$ of C, P and Si in the base steel sheet.

Claim 4. (currently amended) The galvanized steel sheet having an excellent in the coating adhesion according to claim 3 ~~characterized in that~~ , wherein in a stage immediately before a coating layer is adhered to the base steel sheet, in order that

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Si contained in the base steel sheet is not selectively oxidized on a surface, the base steel sheet is heat treated before the coating layer is adhered.

Claim 5. (currently amended) The galvanized steel sheet having an excellent in the coating adhesion according to claim 3 ~~characterized in that in~~ , which further comprises an oxide of silicon being contained in a base steel immediate sheet immediately below the interface ~~an oxide of silicon is contained.~~

Claim 6. (currently amended) The galvanized steel sheet having an excellent in the coating adhesion according to claim 3 ~~characterized in that~~ , wherein the base steel sheet has a composition that further ~~includes~~ comprises, by mass percent, 5 percent or less of Mn, 0.01 percent or less of S and 0.08 percent or less of Al.

Claim 7. (currently amended) The galvanized steel sheet having an excellent in the coating adhesion according to claim 3 ~~characterized in that~~ , wherein the base steel sheet has a composition that further ~~includes~~ comprises at least one ~~kind~~ metal selected from the group consisting of 0.2 percent or less

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of Ti, 0.2 percent or less of Nb and 0.2 percent or less of V, by mass percent.

Claim 8. (withdrawn - currently amended) A method of manufacturing a galvanized steel sheet having an excellent in-
~~the coating adhesion characterized in that~~ comprising a base steel sheet that contains, by mass percent, 0.25 percent or less of C, 0.03 to 2.0 percent of Si and 0.005 to 0.07 percent of P, with the balance being Fe and inevitable impurities, and has a composition satisfying the following equation (1) [[is]], said
base steel sheet being heat treated so that Si in the steel is not selectively surface oxidized, followed by cooling to a coating temperature in an atmosphere having an oxygen concentration of 0.005 volume percent or less, ~~further~~ followed by dipping the base steel sheet in a molten zinc coating bath to form a coating layer, ~~still-further~~ followed by heating at a temperature rise speed of 20 degree centigrade/s or more to a temperature range of 460 to 600 ~~degree~~ degrees centigrade and holding in the heating temperature range to apply a galvannealing process of the coating layer~~[[.]]~~ ,

Note

$$[C] + [P] \leq [Si] \quad (1)$$

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Here wherein, [C], [P] and [Si], respectively, mean the contents [[[]] in mass percent [[()]] of C, P and Si in the base steel sheet.

Claim 9. (withdrawn - currently amended) The method of manufacturing a galvanized steel sheet having an excellent in- ~~the~~ coating adhesion according to claim 8 ~~characterized in that~~, wherein the base steel sheet has a composition that further ~~includes~~ comprises, by mass percent, 5 percent or less of Mn, 0.01 percent or less of S and 0.08 percent or less of Al.

Claim 10. (withdrawn - currently amended) The method of manufacturing a galvanized steel sheet having an excellent in- ~~the~~ coating adhesion according to claim 8 ~~characterized in that~~, wherein the base steel sheet has a composition that further ~~includes~~ comprises at least one ~~kind~~ metal selected from the group consisting of 0.2 percent or less of Ti, 0.2 percent or less of Nb and 0.2 percent or less of V, by mass percent, and the temperature rise speed and a content of Si in the base steel sheet satisfy the following equation (2) [[.]] :

Note

$$ST \geq 3.25/[Si] \quad (2)$$

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Here wherein , in the equation (2), ST designates a temperature rise speed $[\text{ }]\text{ in degree centigrade/s }[\text{ }]$ and [Si] designates a content $[\text{ }]\text{ in mass percent }[\text{ }]$ of Si in the steel sheet.

Claim 11. (withdrawn - currently amended) The galvanized steel sheet having an excellent ~~in the~~ coating adhesion according to claim 2 ~~characterized in that~~ , wherein the base steel sheet contains, by mass percent, 0.25 percent or less of C, 0.03 to 2.0 percent of Si and 0.005 to 0.07 percent of P and has a composition satisfying the following equation (1) $[\text{ }]$:

Note

$$[\text{C}] + [\text{P}] \leq [\text{Si}] \quad (1)$$

Here wherein, [C], [P] and [Si], respectively, mean the contents $[\text{ }]\text{ in mass percent }[\text{ }]$ of C, P and Si in the base steel sheet.

Claim 12. (withdrawn - currently amended) The galvanized steel sheet having an excellent ~~in the~~ coating adhesion according to claim 11 ~~characterized in that~~ , wherein in a stage immediately before a coating layer is adhered to the base steel sheet, in order that Si contained in the base steel sheet is not

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selectively oxidized on a surface, the base steel sheet is heat treated before the coating layer is adhered.

Claim 13. (withdrawn - currently amended) The galvanized steel sheet having an excellent ~~in the~~ coating adhesion according to claim 11 ~~characterized in that~~ , which further comprises an oxide of silicon being contained in a base steel ~~immediate~~ sheet immediately below the interface ~~an oxide of silicon is contained~~.

Claim 14. (withdrawn - currently amended) The galvanized steel sheet having an excellent ~~in the~~ coating adhesion according to claim 11 ~~characterized in that~~ , wherein the base steel sheet has a composition that further ~~includes~~ comprises, by mass percent, 5 percent or less of Mn, 0.01 percent or less of S and 0.08 percent or less of Al.

Claim 15. (withdrawn - currently amended) The galvanized steel sheet having an excellent ~~in the~~ coating adhesion according to claim 11 ~~characterized in that~~ , wherein the base steel sheet has a composition that further ~~includes~~ comprises at least one ~~kind~~ metal selected from the group consisting of 0.2 percent or

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less of Ti, 0.2 percent or less of Nb and 0.2 percent or less of V, by mass percent.

Claim 16. (withdrawn - currently amended) The method of manufacturing a galvanized steel sheet having an excellent in-
~~the~~ coating adhesion according to claim 9 ~~characterized in that~~
, wherein the base steel sheet has a composition that further
~~includes~~ comprises at least one ~~kind~~ metal selected from the
group consisting of 0.2 percent or less of Ti, 0.2 percent or
less of Nb and 0.2 percent or less of V, by mass percent and the
temperature rise speed and a content of Si in the base steel
sheet satisfy the following equation (2) [[.]] :

Note

$$ST \geq 3.25/[Si] \quad (2)$$

~~Here~~ wherein, in the equation (2), ST designates a
temperature rise speed [[()]] in degree centigrade/s [[()]] and
[Si] designates a content [[()]] in mass percent [[()]] of Si in
the steel sheet.

Claim 17. (new) The galvanized steel sheet having an excellent
coating adhesion according to claim 7, wherein Ti, Nb, V and P
satisfy the following equation: $[Ti] + [Nb] + [V] \geq [P]$, wherein

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[Ti], [Nb], [V] and [P] are the amounts of Ti, Nb, V and P, respectively, in mass percent.

Claim 18. (new) The galvanized steel sheet having an excellent coating adhesion according to claim 3, wherein the base steel sheet has a composition which further comprises at least one element selected from the group consisting of 0.5 mass % or less Cr, 1.0 mass % or less Mo, 0.5 mass % or less Cu, 0.5 mass % or less Ni, 0.01 mass % or less Ca, 0.003 mass % or less B and 0.05 mass % or less Sb.